

# JX30

## ORIGINAL CONTRIBUTION

# The Spread of the Obesity Epidemic in the United States, 1991-1998

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**A**LTHOUGH ATTEMPTS TO LOSE weight are common in the United States,<sup>1,2</sup> the prevalence of obesity has increased since the 1980s.<sup>3,4</sup> Such increases will tremendously affect public health since obesity is strongly associated with several chronic diseases, such as cardiovascular diseases and diabetes.<sup>5,6</sup> Recent estimates suggest that obesity-related morbidity may account for 6.8% of US health care costs.<sup>7</sup>

Recently published trend data from the National Health and Nutrition Examination Surveys (NHANES) show the percentage of obese persons has increased from 14.5% in the years 1976-1980 to 22.5% in 1988-1994.<sup>3</sup> To monitor obesity trends since 1994 and to present state-specific results, we used data from a large population-based survey to examine changes in the prevalence of obesity among adults in the United States from 1991 to 1998.

## METHODS

We analyzed data from all states that participated in the Behavioral Risk Factor Surveillance System (BRFSS). The BRFSS, a cross-sectional telephone survey of noninstitutionalized adults aged 18 years or older, is conducted by the Centers for Disease Control and Prevention and state health departments.

**See also Patient Page.**

**Context** The increasing prevalence of obesity is a major public health concern, since obesity is associated with several chronic diseases.

**Objective** To monitor trends in state-specific data and to examine changes in the prevalence of obesity among adults.

**Design** Cross-sectional random-digit telephone survey (Behavioral Risk Factor Surveillance System) of noninstitutionalized adults aged 18 years or older conducted by the Centers for Disease Control and Prevention and state health departments from 1991 to 1998.

**Setting** States that participated in the Behavioral Risk Factor Surveillance System.

**Main Outcome Measures** Body mass index calculated from self-reported weight and height.

**Results** The prevalence of obesity (defined as a body mass index  $\geq 30$  kg/m<sup>2</sup>) increased from 12.0% in 1991 to 17.9% in 1998. A steady increase was observed in all states; in both sexes; across age groups, races, educational levels; and occurred regardless of smoking status. The greatest magnitude of increase was found in the following groups: 18- to 29-year-olds (7.1% to 12.1%), those with some college education (10.6% to 17.8%), and those of Hispanic ethnicity (11.6% to 20.8%). The magnitude of the increased prevalence varied by region (ranging from 31.9% for mid Atlantic to 67.2% for South Atlantic, the area with the greatest increases) and by state (ranging from 11.3% for Delaware to 101.8% for Georgia, the state with the greatest increases).

**Conclusions** Obesity continues to increase rapidly in the United States. To alter this trend, strategies and programs for weight maintenance as well as weight reduction must become a higher public health priority.

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The BRFSS questionnaire concerns personal behaviors that increase risk for 1 or more of the 10 leading causes of death in the United States.<sup>8</sup>

The BRFSS uses a multistage cluster design based on random digit dialing methods to select a representative sample from each state's noninstitutionalized residents.<sup>9,10</sup> Data collected from each state are pooled to produce nationally representative estimates.<sup>9</sup> Further details about the BRFSS have been published.<sup>9,10</sup>

We calculated body mass index (BMI) (weight in kilograms divided by the square of height in meters) based on self-reported weight and height. Participants were classified as obese if their BMI was greater than or equal to 30 kg/m<sup>2</sup>.<sup>11</sup> Questions on leisure-time physical ac-

tivity were included in the BRFSS only in 1991, 1992, 1994, 1996, and 1998 and were used to create a leisure-time physical activity score: inactive, irregularly active, regular, not intense, and regular, intense.<sup>12</sup> We used SAS and SUDAAN statistical software in the analyses and to account for the complex sampling design.<sup>13,14</sup> Because of the large sample size (more than 100 000 participants each year), we have not emphasized statistical testing.

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## THE SPREAD OF OBESITY IN THE UNITED STATES

**Table 1.** Obesity Prevalence in Adults and Mean Weight by Year, 1991 to 1998\*

	Year							
	1991	1992	1993	1994	1995	1996	1997	1998
Obese, %								
Total	12.0 (0.18)	12.7 (0.17)	13.6 (0.17)	14.4 (0.18)	15.3 (0.20)	15.8 (0.17)	16.4 (0.16)	17.9 (0.17)
Men	11.7 (0.26)	12.3 (0.24)	13.7 (0.26)	14.6 (0.28)	15.6 (0.32)	15.5 (0.25)	16.6 (0.26)	17.7 (0.25)
Women	12.2 (0.24)	13.0 (0.23)	13.5 (0.22)	14.2 (0.23)	14.9 (0.24)	16.1 (0.22)	16.3 (0.22)	18.1 (0.23)
Weight, kg								
Total	73.1 (0.09)	73.6 (0.08)	74.0 (0.08)	74.5 (0.09)	75.0 (0.10)	75.2 (0.08)	75.5 (0.08)	76.2 (0.08)
Men	81.5 (0.12)	82.0 (0.11)	82.4 (0.11)	83.1 (0.12)	83.5 (0.15)	83.4 (0.11)	83.8 (0.11)	84.4 (0.11)
Women	65.1 (0.10)	65.7 (0.09)	66.1 (0.09)	66.4 (0.09)	66.9 (0.10)	67.4 (0.09)	67.6 (0.09)	68.4 (0.09)

\*Data were collected using the Behavioral Risk Factor Surveillance System, a cross-sectional random-digit telephone survey. Data in parentheses are SE.

**Table 2.** Changes in Obesity Prevalence in Adults by Characteristics\*

Characteristic	1991	1998	Difference	% Increase
Sex				
Men	11.7 (0.26)	17.7 (0.25)	6.0	51.5
Women	12.2 (0.24)	18.1 (0.23)	5.9	47.4
Age, y				
18-29	7.1 (0.29)	12.1 (0.34)	5.0	69.9
30-39	11.3 (0.34)	16.9 (0.35)	5.6	49.5
40-49	15.8 (0.48)	21.2 (0.41)	5.4	34.3
50-59	16.1 (0.58)	23.8 (0.51)	7.7	47.9
60-69	14.7 (0.52)	21.3 (0.53)	6.6	44.9
≥70	11.4 (0.53)	14.6 (0.42)	3.2	28.6
Race				
White	11.3 (0.18)	16.6 (0.18)	5.3	47.3
Black	19.3 (0.68)	26.9 (0.62)	7.6	39.2
Hispanic	11.6 (0.76)	20.8 (0.74)	9.2	80.0
Other	7.3 (0.88)	11.9 (0.87)	4.6	62.0
Education levels				
< High school	16.5 (0.48)	24.1 (0.56)	7.6	46.0
High school	13.3 (0.30)	19.4 (0.30)	6.1	46.1
Some college	10.6 (0.36)	17.8 (0.32)	7.2	67.5
≥ College	8.0 (0.30)	13.1 (0.27)	5.0	62.9
Smoking status				
Never	12.0 (0.24)	17.9 (0.24)	5.9	48.5
Ex-smoker	14.0 (0.37)	20.9 (0.36)	6.9	49.4
Current	9.9 (0.32)	14.8 (0.33)	4.9	50.3

\*Data are presented as mean (SE) percentage unless otherwise indicated.

We excluded from our trend analyses 6 states because they did not collect weight and height for 1 or more years: Arkansas (1992), the District of Columbia (1995), Kansas (1991), Nevada (1991), Rhode Island (1994), and Wyoming (1991, 1992, and 1993). However, we included the data for all available years for these and all other states in our maps. We used the US Bureau of Census method of grouping states into regions.

## RESULTS

The prevalence of obesity increased from 12.0% in 1991 to 17.9% in 1998 (TABLE 1). Obesity increased in men and

women and across all sociodemographic groups (TABLE 2), with the highest increase among the youngest ages and higher education levels. Among Hispanic men, the prevalence of obesity increased from 10.0% in 1991 to 18.3% in 1997 and for Hispanic women from 13.2% to 23.4%. The prevalence of obesity increased steadily from 1991 to 1998 in all states (FIGURE).

In 1991, 4 of the 45 participating states had obesity rates of 15% or higher (TABLE 3). By 1998, 37 states had rates higher than 15%. The magnitude of the increase varied by region (ranging from 31.9%-67.2% increase in the mid Atlan-

tic and South Atlantic regions, respectively) and by state, ranging from 11.3% in Delaware to 101.8% in Georgia.

In 1991, the level of leisure-time physical activity was 29.7% inactive, 28.4% irregularly active, 33.2% regular not intense, and 8.7% regular intense. In 1998, they were 28.6% inactive, 28.2% irregularly active, 29.6% regular not intense, and 13.6% regular intense.

To exclude the possibility that demographic differences accounted for the variation in obesity prevalence between the states, we computed the age-, sex-, and race-adjusted prevalence of obesity. Although the adjusted rates were higher than the unadjusted rates, similar patterns were observed among states and over time. Therefore, we only report the unadjusted estimates.

## COMMENT

These data show that obesity increased in every state, in both sexes, and across all age groups, races, educational levels, and smoking statuses. Rarely do chronic conditions such as obesity spread with the speed and dispersion characteristic of a communicable disease epidemic. However, this rapid trajectory of obesity may present both clues to origin and measures for efficient attempts to control its spread.

Since overweight participants in self-reported studies tend to underestimate their weight and all participants tend to overestimate their height; true rates of obesity are likely underestimated.<sup>15,16</sup> Moreover, people without telephones are not surveyed through BRFSS, and such individuals are likely to be of lower socioeconomic status, a factor that is as-

## THE SPREAD OF OBESITY IN THE UNITED STATES

sociated with obesity.<sup>17,18</sup> The net effect of these limitations is that the prevalence of obesity reported herein is likely a conservative estimate. In fact, the prevalence of obesity from NHANES III (1988-1994) in which weight and height were measured by health professionals was 22.5% in adults, more than a third higher than the rates reported in our survey.<sup>3</sup>

The BRFSS data provide states with unique population-based estimates of self-reported obesity against which prevention efforts may be evaluated. State-level population-based estimates of obesity should be used to provide each state with a basis for setting priorities for public health interventions.

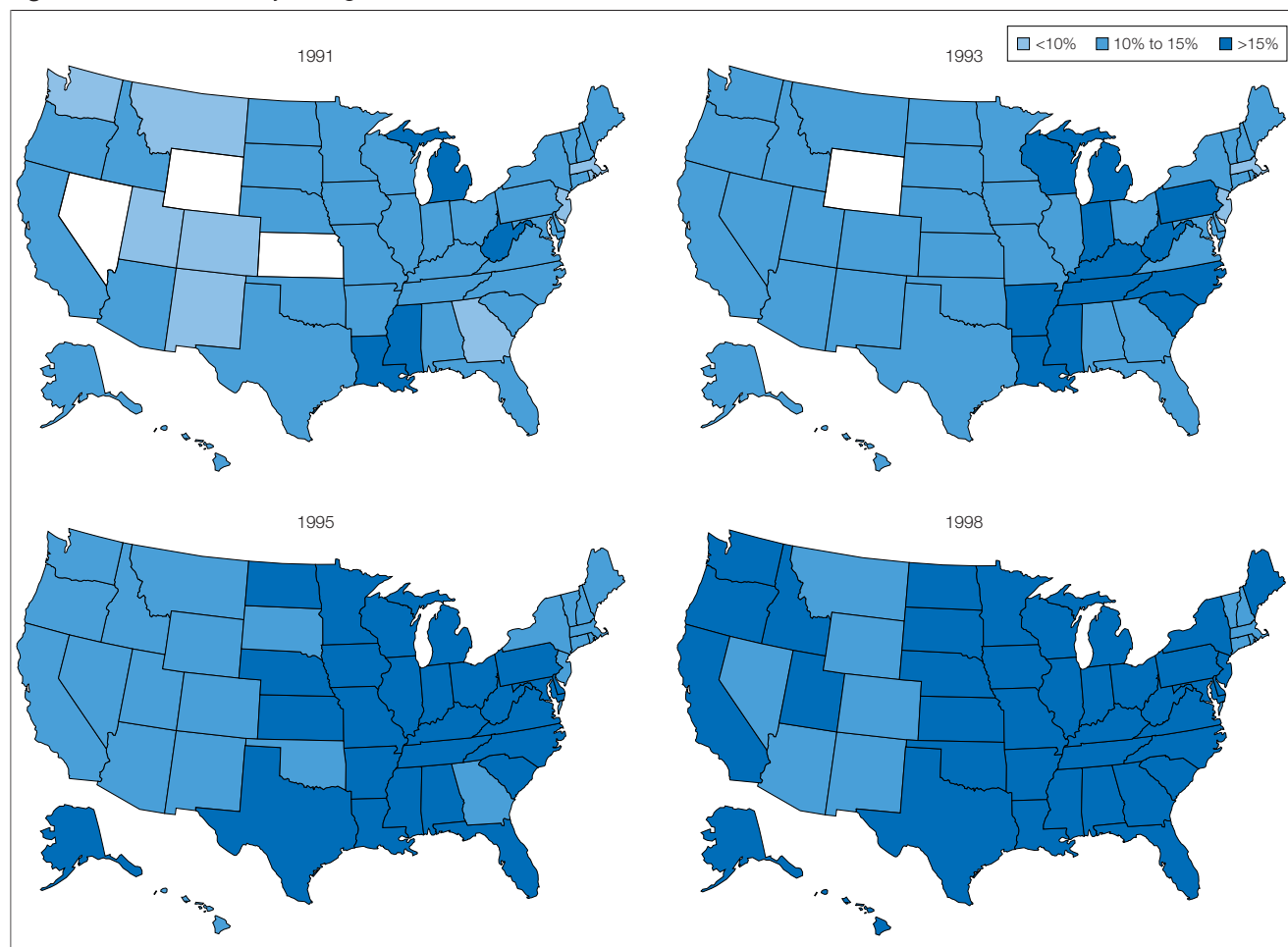
This rapid increase in obesity in all segments of the population and regions of the country implies that there have been sweeping changes in US society that are contributing to weight gain by fostering energy intake imbalance. Such changes are unlikely to be due to diminished individual motivation to maintain weight or in genetic or other biological changes in the population.

We focused on describing the changes in patterns of obesity instead of its contributory factors, such as alterations in diet, activity patterns, or other behaviors that affect energy balance. However, our data demonstrate that a major contributor to obesity—physical inactivity—has not changed

substantially at the population level between 1991 and 1998. By focusing on the challenge of stopping the obesity epidemic and the profound negative health consequences of obesity, it is important to increase the awareness and involvement of health professionals in dealing with the epidemic.

Our data suggest that the development of strategies and programs for weight maintenance as well as weight reduction must become a higher priority. Public health messages should focus increasingly on balancing energy intake with physical activity. To control the obesity epidemic, a wide range of population groups, including physicians and other health care profes-

**Figure.** Prevalence of Obesity Among US Adults From Years 1991, 1993, 1995, and 1998



Data were calculated using the Behavioral Risk Factor Surveillance System. States are white in the years 1991 and 1993 because information on weight and height was not collected.

## THE SPREAD OF OBESITY IN THE UNITED STATES

**Table 3.** Changes in Obesity Prevalence in Adults by Region and State\*

	1991	1998	Difference	% Increase
New England	9.9 (0.52)	14.4 (0.43)	4.5	45.8
Maine	12.1 (1.08)	17.0 (1.07)	4.9	40.1
New Hampshire	10.4 (0.87)	14.7 (1.05)	4.3	40.9
Vermont	10.0 (0.83)	14.4 (0.74)	4.3	42.9
Massachusetts	8.8 (0.82)	13.8 (0.68)	5.0	56.0
Connecticut	10.9 (0.85)	14.7 (0.83)	3.8	34.4
Mid Atlantic	12.7 (0.51)	16.7 (0.50)	4.0	31.9
New York	12.8 (0.85)	15.9 (0.84)	3.1	24.2
New Jersey	9.7 (0.88)	15.2 (0.89)	5.5	57.0
Pennsylvania	14.4 (0.81)	19.0 (0.77)	4.6	32.0
East north central	14.1 (0.45)	19.1 (0.43)	5.0	35.6
Ohio	14.9 (1.18)	19.5 (1.05)	4.6	31.0
Indiana	14.8 (0.83)	19.5 (0.90)	4.7	31.6
Illinois	12.7 (0.84)	17.9 (0.83)	5.2	40.1
Michigan	15.2 (0.84)	20.7 (0.91)	5.5	35.9
Wisconsin	12.7 (0.99)	17.9 (0.97)	5.2	41.1
West north central	12.2 (0.41)	18.0 (0.40)	5.8	48.1
Minnesota	10.6 (0.57)	15.7 (0.60)	5.1	47.6
Iowa	14.4 (1.01)	19.3 (0.78)	4.9	33.9
Missouri	12.0 (0.90)	19.8 (0.92)	7.8	65.0
North Dakota	12.9 (0.87)	18.7 (1.03)	5.8	44.7
South Dakota	12.8 (0.89)	15.4 (0.94)	2.6	20.2
Nebraska	12.5 (1.03)	17.5 (0.81)	5.0	39.8
South Atlantic	11.1 (0.34)	18.6 (0.35)	7.5	67.2
Delaware	14.9 (1.07)	16.6 (1.02)	1.7	11.3
Maryland	11.2 (0.92)	19.8 (0.96)	8.6	75.8
Virginia	10.1 (0.84)	18.2 (0.95)	8.1	80.3
West Virginia	15.2 (0.88)	22.9 (0.96)	7.7	50.2
North Carolina	13.0 (0.91)	19.0 (1.06)	6.0	46.4
South Carolina	13.8 (0.94)	20.2 (0.87)	6.4	46.7
Georgia	9.2 (0.75)	18.7 (0.93)	9.5	101.8
Florida	10.1 (0.75)	17.4 (0.65)	7.3	71.8
East south central	13.1 (0.44)	20.0 (0.46)	6.9	52.1
Kentucky	12.7 (0.86)	19.9 (0.75)	7.2	55.9
Tennessee	12.1 (0.74)	18.5 (0.84)	6.4	53.0
Alabama	13.2 (0.88)	20.7 (1.05)	7.5	56.6
Mississippi	15.7 (1.11)	22.0 (1.00)	6.3	40.2
West south central	13.1 (0.73)	19.9 (0.51)	6.8	51.9
Louisiana	15.7 (1.16)	21.3 (1.10)	5.6	35.6
Oklahoma	11.9 (0.89)	18.7 (0.89)	6.8	57.6
Texas	12.7 (0.99)	19.9 (0.65)	7.2	56.0
Mountain	9.6 (0.40)	14.1 (0.60)	4.5	46.9
Montana	9.4 (0.92)	14.7 (0.89)	5.3	56.0
Idaho	11.7 (0.85)	16.0 (0.62)	4.3	37.1
Colorado	8.4 (0.72)	14.0 (0.96)	5.6	66.6
New Mexico	7.8 (0.93)	14.7 (0.66)	6.9	89.0
Arizona	11.0 (0.93)	12.7 (1.58)	1.7	15.6
Utah	9.7 (0.77)	15.3 (0.91)	5.6	56.8
Pacific	10.2 (0.49)	17.0 (0.53)	6.8	66.8
Washington	9.9 (0.72)	17.6 (0.80)	7.7	77.2
Oregon	11.2 (0.60)	17.8 (0.99)	6.6	59.1
California	10.0 (0.63)	16.8 (0.69)	6.8	66.7
Alaska	13.1 (1.27)	20.7 (1.29)	7.6	57.7
Hawaii	10.4 (0.80)	15.3 (1.10)	4.9	47.1

\*Data are presented as percentage and mean (SE) unless otherwise indicated.

sionals, public health professionals, legislators, communities, work sites, and organizations, must become engaged in working toward a solution.

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## REFERENCES

1. Serdula MK, Williamson DF, Anda RF, Levy A, Heathon A, Byers T. Weight control practices in adults. *Am J Public Health*. 1994;84:1821-1824.
2. Williamson DF, Serdula MK, Anda RF, Levy A, Byers T. Current weight loss attempts in adults. *Am J Public Health*. 1992;82:1251-1257.
3. Flegal KM, Carroll MD, Kuczmarski RJ, Johnson CL. Overweight and obesity trends in the United States: prevalence and trends, 1960-1994. *Int J Obes Relat Metab Disord*. 1998;22:39-47.
4. Galuska DA, Serdula M, Pamuk E, Siegel P, Byers T. Trends in overweight among US adults from 1987 to 1993: a multistate telephone survey. *Am J Public Health*. 1996;86:1729-1735.
5. National Institutes of Health Consensus Development Panel on Health Implications of Obesity. Health implications of obesity. *Ann Intern Med*. 1985;103:1073-1077.
6. Pi-Sunyer FX. Health implications of obesity. *Am J Clin Nutr*. 1991;53(suppl 6):1595S-1603S.
7. Wolf AM, Colditz GA. Social and economic effects of body weight in the United States. *Am J Clin Nutr*. 1996;63(suppl 3):466S-469S.
8. Remington PL, Smith MY, Williamson DF, Anda RF, Gentry EM, Hogelin CG. Design, characteristics, and usefulness of state-based behavioral risk factor surveillance: 1981-1987. *Public Health Rep*. 1988;103:366-375.
9. Waksberg JS. Methods for random digit dialing. *J Am Stat Assoc*. 1978;73:40-46.
10. Nelson DE, Holtzman D, Waller M, Leutzinger CL, Condon K. Objectives and design of the Behavioral Risk Factor Surveillance System. In: Proceedings of the Section on Survey Methods of the American Statistical Association National Meeting; August 10, 1998; Dallas, Tex.
11. WHO Expert Committee on Physical Status. *The Use and Interpretation of Anthropometry: Report of a WHO Expert Committee*. Geneva, Switzerland: World Health Organization; 1995. World Health Organization Technical Report Series 854.
12. Caspersen CJ, Pollard RA, Pratt SO. Scoring physical activity data with special consideration for elderly populations. In: Proceedings of the 21st National Meeting of the Public Health Conference on Records and Statistics: Data for an Aging Population; July 13-15, 1987; Hyattsville, Md. National Center for Health Statistics/Dept of Health and Human Services publication PHS 88-1214.
13. SAS System [computer program], Version 6.12. Cary, NC: SAS Institute Inc; 1998.
14. Shah BV, Barnwell BG, Bieler GS. *SUDAAN User's Manual, Release 7.5*. Research Triangle Park, NC: Research Triangle Institute; 1997.
15. Rowland ML. Self-reported weight and height. *Am J Clin Nutr*. 1990;52:1125-1133.
16. Palta M, Prineas RJ, Berman R, Hannan P. Comparison of self-reported and measured height and weight. *Am J Epidemiol*. 1982;115:223-230.
17. Aday LA. *Designing and Conducting Health Surveys: A Comprehensive Guide*. San Francisco, Calif: Jossey-Bass Publishers; 1989:79-80.
18. Bray GA. An approach to the classification and evaluation of obesity. In: Bjorntrop P, Brodoff BN, eds. *Obesity*. Philadelphia, Pa: JB Lippincott Co; 1992:301.